Method and system for preparation of a medical solution, for example a dialysis solution.

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Abstract

The present invention relates to a method and a system for preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are supplied successively to a number of dosage points (A,B,C) along a main conduit (2) which leads from a water source (1) to a point of consumption, such as a dialyzer. The method is characterized in that acid is supplied in gas form and the system is characterized in that one of said dosage points (A,B,C) constitutes a gas inlet for the intake of said acid in gas form.

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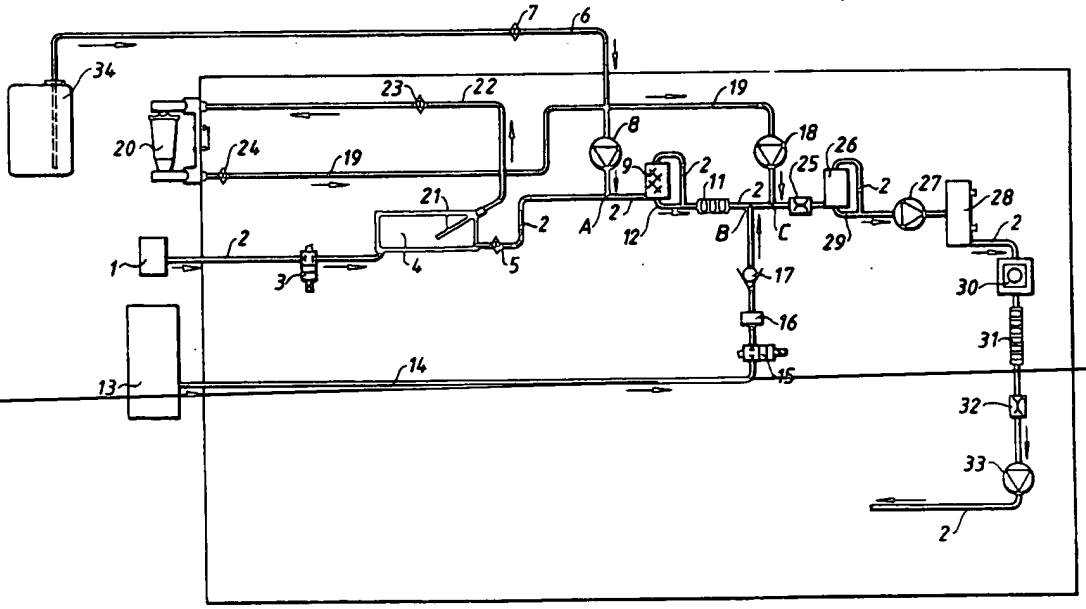
(54) Method and system for preparation of a medical solution, for example a dialysis solution.

(57) The present invention relates to a method and a system for preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are supplied successively to a number of dosage points (A,B,C) along a main conduit (2) which leads from a water source (1) to a point of consumption, such as a dialyzer.

The method is characterized in that acid is supplied in gas form and the system is characterized in that one of said dosage points (A,B,C) constitutes a gas inlet for the intake of said acid in gas form.



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TECHNICAL FIELD

The present invention relates to a method for preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are supplied successively to a number of dosage points along a main conduit which leads from a water source to a place of consumption, such as a dialyzer.

The invention also relates to a system for continuous preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are arranged to be supplied successively to a number of dosage points along a main conduit which leads from a water source to a place of consumption, such as a dialyzer.

The invention is preferably intended to be applied to dialysis systems which use bicarbonate as the buffer.

BACKGROUND ART

A method for preparation of a dialysis solution using bicarbonate as the buffer is described in, for example, EP-B1-0 022 922. A more complete system for preparation of a medical solution, preferably intended for dialysis, is described in US-A-4 784 495. The invention according to the American patent can be said to form a substantial improvement or development of the invention according to the European patent. In much the same way, the present invention can be said to be a further improvement or further development of the earlier inventions. The contents of the two above-mentioned patents are thus included in the present description.

According to the European patent, two liquid concentrates are used. In short, the improvement according to the American patent can be said to involve the partial replacement of these liquid concentrates with one or more concentrates in powder form. However, a certain quantity of liquid concentrate must still be used, which is disadvantageous.

DESCRIPTION OF THE INVENTION

According to the present invention, liquid concentrates can be totally avoided. However, the invention also includes the methods and respective systems in which a part of the concentrate for various special reasons is supplied in liquid form.

The invention thus relates to a method for preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are supplied successively to a number of dosage points along a main conduit which leads from a water source to a point of consumption, such as a dialyzer. The invention is characterized in that the acid is supplied in a gas form. This thus makes it possible that the other concentrates, where desired, can be supplied in powder form for dissolving in situ. This means that the transportation of large quantities of liquid over long distances is not needed. The only liquid which is absolutely required is thus water. Furthermore, a considerable advantage from a medical point of view is gained, namely that bacteria growth in a powder form concentrate is normally considerably less than in a concentrate in liquid form. A further advantage is that a concentrate can be supplied in the form of a pure acid.

As such, no change of the concentration needs to take place for the metal salts added via respective concentrates. Previously, in connection with dialysis, the acid has been included in a concentrate together with a number of metal salts.

Preferably the invention is intended to be used in connection with a method applied to a dialysis system which uses sodium bicarbonate as the buffer and to which calcium is also supplied. In such a case, the addition of the acid in gas form ought to occur before these substances are blended. In this way the risk of precipitation of solid calcium carbonate is reduced.

Surplus gas which is supplied, if any, can be removed in connection with normal degassing. Thereafter this can possibly be recirculated. This can be desirable, partially from an economic point of view and partially for facilitating the control of the finally supplied quantity of gas.

The control of the supplied quantity of gas can also be facilitated by measuring the pH-value of the prepared solution after the addition of gas and using this for its regulation.

Considerable advantages, such as from a transportation point of view, are gained if the gas is prepared in situ. If this concerns a dialysis system which uses sodium bicarbonate as the buffer, then it is suitable that CO_2 is chosen as such a gas. This can be prepared in situ by mixing a carbonate, preferably sodium bicarbonate, with acid and water. A suitable acid for the preparation is citric acid.

Alternatively, CO_2 can be prepared in situ by heating a carbonate, preferably sodium bicarbonate, to a suitable temperature, such as above 50 °C. From a hygienic view point, it can be appropriate that water formed during the preparation is separated off before the supply to the main line.

The invention thus relates also to a system for continuous preparation of a medical solution, for example a dialysis solution from water and a plural-

ity of concentrates, including an acid, whereby respective concentrates are arranged to be supplied successively to a number of dosage points along a main conduit which leads from a water source to a point of consumption, such as a dialyzer. The system is characterized in that one of said dosage points constitutes a gas inlet for the intake of said acid in gas form.

The invention is preferably intended to be applied to a system adapted for use for dialysis with sodium bicarbonate as the buffer and to which calcium is also supplied. In such a case, the dosage inlet point for the acid in gas form should be positioned between the dosage points for these substances.

The system preferably includes means for measuring the pH-value after the addition of gas. Other measuring devices can however also be used, such as a conductivity meter.

Considerable advantages are attained if the system includes means for preparation of the acid in gas form in situ, such as a device for preparation of CO_2. Other gases can however also be used, such as hydrochloric acid in gas form.

BRIEF DESCRIPTION OF THE DRAWING

In the attached drawing a system or a plant for preparation of a medical solution, preferably a dialysis solution, is shown in simple block form. For the sake of clarity, less important details for the invention have been omitted.

PREFERRED EMBODIMENT OF A SYSTEM ACCORDING TO THE INVENTION

A preferred embodiment of a system according to the invention is hereby shown in the drawing. In the drawing, water is supplied from a source 1, for example a reverseosmosis unit. Alternatively, the source 1 can constitute a hospital's central system in which water has already been supplied with one or more concentrates in fixed concentrations. In the following, the expression water source is meant not solely a source for pure water, but also sources for water to which one or more substances have been added. The water is fed via a main conduit 2 with a valve 3 to a heating vessel 4, where it is heated to a temperature, for example circa 37 °C. The main conduit 2 then continues via a filter 5 to a mixing point A. A liquid-based concentrate is supplied from a reservoir 34 via a conduit 6 with a filter 7. Alternatively, this concentrate can be supplied in powder form and dissolved in situ by water from the water source 1 being fed therethrough, as is described for example in the above-mentioned American patent 4 784 495 or in the Swedish patent application 90.00586-9. The concentrate from the source 34 or concentrate prepared in the abovementioned way is supplied to the main conduit 2 with the aid of a pump 8.

In order to achieve good mixing, the water and concentrate are fed to a mixing vessel 9 and from there to a conductivity meter 11. So that the mixing vessel 9 can be emptied after treatment has been carried out, it is provided with a separate drainage conduit 12 at its base. The conductivity meter 11 is appropriately arranged to control the pump 8 in order to achieve the correct mixing ratio between water and concentrate.

According to the invention, a concentrate is supplied to the main conduit 2 in the form of a gaseous acid. This acid is drawn from a reservoir 13 therefor. This reservoir 13 can either consist of a gas bottle with suitable gas, for example carbon dioxide or HCl in gas form. Alternatively, it can consist of a device for preparing the gas in situ. By way of example, CO_2 can be prepared in situ by means of a carbonate, preferably sodium carbonate, being mixed with acid and water. An example of a suitable acid for this purpose is citric acid. Alternatively, CO_2 can be prepared by warming a carbonate, preferably sodium carbonate, to a suitable temperature, such as over 50 °C.

The gas from the reservoir 13 is then led through a conduit 14, a valve 15, a flow regulation valve 16 and a non-return valve 17 to a mixing point B in the main conduit 2.

A third concentrate from a reservoir 20 in the form of a powder cartridge is then supplied to a point C in the main conduit with the aid of a pump 18 via conduit 19. The powder therein is dissolved continuously by water being drawn from the heating vessel via a tube 21 and a conduit 22 with a filter 23. The conduit 19 also includes a filter which is designated by 24. The dissolving of the powder in the cartridge 20 can occur in a way as described in the above-mentioned American patent 4 784 495.

The prepared liquid is delivered from the mixing point C via a throttle 25 and bubble chamber 26 with the aid of a pump 27 to a bubble trap 28. Through this arrangement, bubbles are formed from mainly air dissolved in the liquid and any surplus gas supplied from the reservoir 13. These bubbles are enlarged in the bubble chamber 26 and removed in the bubble trap 28 in a not shown way. These, together with a smaller quantity of liquid, can possibly be led directly to a drain or may also be recirculated so that surplus gas can also be dissolved. Like the mixing vessel 9, the bubble chamber 26 is also provided with a drainage conduit 29 at its base. Thus, this can be completely emptied when the system for example is to be cleaned.

The main conduit 2 extends from the bubble

trap 28 via a pH-meter 30, a conductivity meter 31, a throttle 32 and a pump 33 to a not shown dialyzer. The pH-meter 30 is hereby suitably arranged to control the flow regulator 16 in the conduit 14. The conductivity meter 31 is further suitably arranged to control the pump 18 in the conduit 19. These pumps can alternatively consist of some type of adjustable dosage pump to which a suitable value can be inputted in relation to the flow of liquid through the main conduit 2.

The components 32 and 33 can be parts of a constant flow device of the type which is described in more detail in the American patent 4 762 618. In such a case, a pressure meter is provided therebetween which controls the pump 33 so that a constant pressure drop is maintained across the throttle 32 and thereby a constant flow to the dialyzer.

EXAMPLE FOR PREPARATION OF CO_2

1. Sodium bicarbonate mixed with acid and water

Acid in dry form, such as citric acid, is mixed in suitable quantities with bicarbonate. For dialysis treatment the suitable quantities are circa 37 g citric acid and 45 g bicarbonate. When water is added, the formation of CO_2 commences. In order to moderate the supply of gas, either the water supply to the powder mixture can be regulated and thereby control the gas production, or the gas can be allowed to be collected in a reservoir under pressure and the supply of gas to the main conduit can be regulated with a flow regulating device.

2. Sodium bicarbonate heated to conversion temperature

Dry sodium bicarbonate is heated to a temperature above 50 • C in a gas-tight vessel which is connected to the point of consumption. The gas production is directly proportional to this supply of energy. In this way, the gas production can be controlled as needed. In order to control the quantity of supplied energy, either the gas flow or the pH-value in the ready dialysis liquid can be measured.

DETAIL INFORMATION

Surplus gas can either be separated off in connection with the normal degassifying or can be brought to recirculate in the system.

Parameters which effect the quantity of supplied acid are, amongst others, the pressure at the dosage intake point, the temperature of the liquid, exposure time for the gas (contact distance/flow velocity) and contact surface (total bubble surface).

Naturally the invention is not restricted to solely the above-described embodiment, but can be varied within the scope of the appended claims. By way of example, other gases such as hydrochloric acid in gas form can be used. The hydrochloric acid need not be in gas form from the outset. Instead this can be generated in situ by mixing for example sodium chloride with a suitable acid, such as sulphuric acid, during heating. However, it is preferable to use CO_2. Furthermore, it should be noted that the conductivity meter 31 can be arranged solely for control of the preparation. In such a case, the flow control valve 16 can totally control the gas flow in the conduit 14. Besides regulating means, in such a case this can also include means for measuring the flow. Furthermore, the parts included in the described system can be varied within wide limits concerning both form and function.

Claims

1. Method for preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are supplied successively to a number of dosage points (A,B,C) along a main conduit (2) which leads from a water source (1) to a point of consumption, such as a dialyzer, **characterized** in that the acid is supplied in gas form.

2. Method according to claim 1, intended for use in a dialysis system which uses bicarbonate as the buffer and to which calcium is also supplied, **characterized** in that the addition of acid in gas form occurs before these substances are blended.

3. Method according to claim 1 or 2, **characterized** in that surplus gas is removed in connection with normal degasing.

4. Method according to any one of the previous claims, **characterized** in that surplus gas, if any, is separated off and recirculated.

5. Method according to any one of the previous claims, **characterized** in that the pH-value for the prepared solution is measured after the gas addition and is used for controlling thereof.

6. Method according to any one of the previous claims, **characterized** in that the gas is prepared in situ.

7. Method according to any one of the previous claims intended for a dialysis system which

uses bicarbonate as the buffer, **characterized** in that CO_2 is chosen as the gas.

8. Method according to claim 7, **characterlz d** in that CO_2 is prepared in situ by mixing a carbonate, preferably sodium bicarbonate, with acid and water.

9. Method according to claim 8, **characterized** in that citric acid is used for preparation of CO_2.

10. Method acccording to claim 7, **characterized** in that CO_2 is prepared in situ by warming a carbonate, preferably sodium bicarbonate, to a suitable temperature, for example over 50 °C.

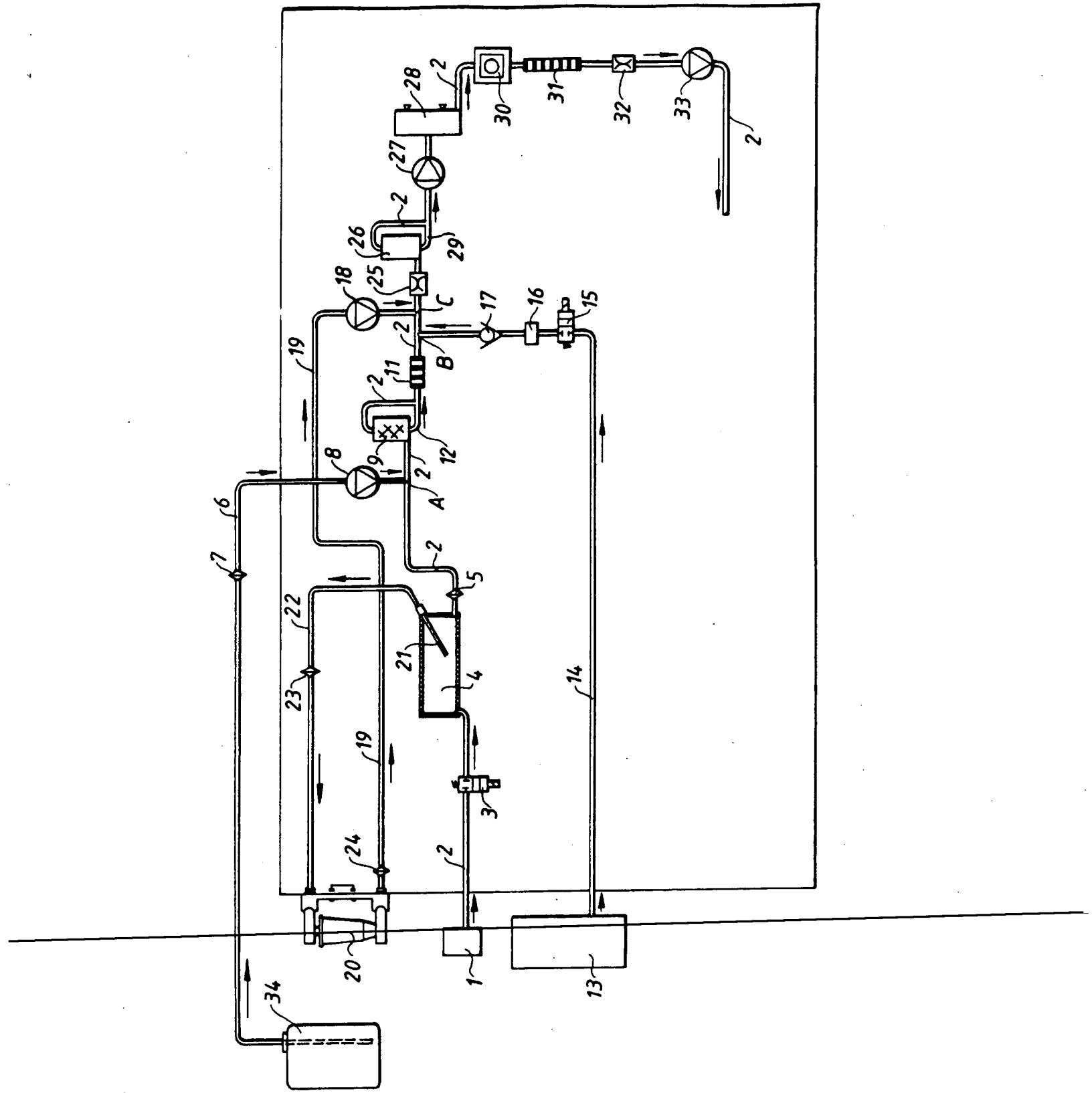
11. Method according to claim 10, **characterized** in that water formed during the preparation is separated off before supply to the main conduit.

12. System for continuous preparation of a medical solution, for example a dialysis solution, from water and a plurality of concentrates, including an acid, whereby respective concentrates are arranged to be supplied successively to a number of dosage points (A,B,C) along a main conduit (2) which leads from a water source (1) to a point of consumption, such as a dialyzer, **characterized** in that one of said dosage points (A,B,C) constitutes a gas inlet (B) for the intake of said acid in gas form.

13. System according to claim 12, adapted for use in dialysis with bicarbonate as the buffer and to which calcium is also supplied, **characterized** in that the dosage inlet point (B) for the acid in gas form is positioned between the dosage points (A and C) for these substances.

14. System according to any of claims 12 and 13, **characterized** by means (30) for measuring the pH-value after the addition of gas.

15. System according to any of claims 12-14, **characterized** by means for preparation of the acid in gas form in situ, such as a device (13) for preparation of CO_2.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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 6381

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 209 607 (DIETL) * Page 2, lines 1-6; abstract; figure 1 *	1	A 61 M 1/16
A	PATENT ABSTRACTS OF JAPAN, vol. 6, no. 49 (C-096), 31st March 1982; & JP-A-56 164 113 (DAIGO MINORU) 17-12-1981 * The whole document *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 61 M

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of search	Examiner
The Hague	20 December 91	PAPONE F.

CATEGORY OF CITED DOCUMENTS

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